SUMMARY REPORT

Integration of Site Specific Management with Global Positioning Systems, Economic Thresholds, Variable Rate Application, and Weed Sensing Sprayer for Reduction of Herbicide Use in Cotton

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INTRODUCTION

Cotton (*Gossypium hirsutum*) requires more herbicide inputs than many other U.S. crops. Although selective herbicide technology has improved over the past 50 years, until recently (1995) cotton was the only major agronomic crop in the U.S. without selective postemergence over-the-top herbicides for control of annual broadleaf weeds. The registrations of pyrithiobac, bromoxynil, and glyphosate for use in non-transgenic and transgenic cotton has provided cotton producers with selective postemergence herbicides. These new technologies have additionally in some cases reduced the rates of herbicide application from kg ai/ha to g ai/ha. Unfortunately, the rapid technological advances in herbicide development have not be seen in application technology. Basically herbicides are being applied with technology that is in many cases over 40 years old.

Weed sensing sprayers, such as evaluated in this research, apply herbicides only where weeds are present and avoid requirements for extensive weed scouting and spatial mapping. The sprayer used in these studies was developed by Patchen, Inc. Sensors emit a light source and the sensor detects the ratio of red to near infrared light reflecting back from the ground and surrounding vegetation. Where green vegetation is present, less red light is reflected thus altering the ratio. Since the current detectors cannot differentiate between green crop and green weed plants, plastic hoods must be used in row crops to exclude crop plants from the detection area. Thus emerged weeds are only going to theoretically be controlled in the row middles which accounts for approximately 70% of the land surface area. One of our research objectives was to evaluate the feasibility of the weed sensing sprayer in this manner, i.e. to use this sprayer to control weeds in the row middle.

To control weeds within the crop drill, one can band herbicides for continuous application on the drill. One additional hypothesis came to mind when we initiated this research. Our additional hypothesis was to use the patchy spatial distribution of weeds against the weeds. Rather than only band herbicides on the drill (on the row) between the hoods, the following system was added in an attempt to use the weed spatial information gained by the weeds sensing hooded sprayer to trigger herbicide applications on the crop row (drill). By triggering a spray application over the drill only when weeds are detected underneath the hood by the sensor in closest proximity to the crop drill; the amount of herbicide used in the crop drill could theoretically be reduced. Information on this feasibility and the feasibility of integrating variable rate application, economic thresholds with a computer based decision aid (HADSS, Herbicide Application Decision Support System), GPS, and the weed sensing sprayer in cotton was evaluated. Our objectives were to determine the feasibility of the aforementioned as related to weed control, crop tolerance, crop yield and grade, and net returns to land and management. Additionally, the amount of herbicide active ingredient used for each system was determined.

Materials and Methods

Studies were conducted in Kinston, NC in 1999 and 2000 using glyphosate-tolerant cotton. A randomized complete block design was replicated five or six times. Plots were 7.7 m wide by 30.5 m long and contained eight 0.96 m crop rows. Preemergence (PRE) herbicides included pendimethalin at 1.1 kg ai/ha plus fluometuron at 1.1 kg ai/ha. The study included the following management systems: 1)PRE herbicides broadcast applied followed by (fb) glyphosate at 0.8 kg ai/ha early postemergence (EPOST) and a LAYBY postemergence directed treatment of prometryn at 0.9 kg ai/ha plus MSMA at 2.2 kg ai/ha; 2) the same PRE herbicides on a 50% band with HADSS-recommended POST herbicides (glyphosate) plus the LAYBY of prometryn plus MSMA; 3) the same PRE herbicides on a 50% band followed by POST and LAYBY herbicides recommended by HADSS; 4) PRE herbicides on a 50% band fb EPOST treatments of glyphosate and glyphosate LAYBY under the hood by the weed sensing sprayer (Patchen); 5) the same as system 4 but with no PRE herbicides; 6) total POST with the Patchen sprayer in the row middles plus triggering a decision on the crop drill (herbicide selection based on HADSS recommendations); 7) same as system one plus hand weedings to keep weed free, and 8) an untreated check.

Summary

Based on the scouting data entered into the HADSS program, rates of herbicides could not be variably applied. We feel this was due to the presence of morningglories which tend to be more tolerant to glyphosate and thus required higher rates of glyphosate for consistent control. Cotton stunting occurred in the total POST system due to early season weed interference in systems that did not use PRE soil applied herbicides. This stunting has been observed in other research reported in *Weed Technology*, *Weed Science*, and the *Cotton Journal*. Weed management systems that used the Patchen weed sensing sprayer used less postemergence herbicides than broadcast treatments in all instances. At the first POST application, these reductions averaged 55%, regardless of the PRE herbicide use or year. However, delayed cotton vigor and growth from early season weeds allowed more weed emergence in plots that did not contain PRE herbicides and spray reductions from use of the weed sensing sprayer late in the season averaged 60% in total POST systems compared to 75% in the systems that used PRE herbicides. All herbicide systems controlled carpetweed (*Mollugo verticillata*), common lambsquarters (*Chenopodium album*), entireleaf morningglory (*Ipomoea hederacea* var. *integriuscula*), goosegrass (*Eleusine indica*), ivyleaf morningglory (*Ipomoea hederacea*), Palmer amaranth (*Amaranthus palmeri*), sicklepod (*Senna obtusifolia*), and slender amaranth (*Amaranthus gracilis*) at least 97% late season with no differences in control. Sicklepod, Palmer amaranth, ivyleaf morningglory, and entireleaf morningglory are among the more common and troublesome weeds in cotton production east of the Mississippi River.

Cotton lint grades did not vary among the herbicide systems, the untreated checks could not be harvested or grades determined because of extreme heavy weed infestations. Cotton lint yields averaged 660 kg lint/ha in 1999 with no differences. In 2000, yield potential was greater due to better growing conditions, rainfall distributions, and amounts. Yield reductions occurred when no PRE herbicides were used. These reductions in yield are likely due to slowed cotton growth resulting from early-season weed interference. Net returns mirrored trends in yield. Although herbicides systems that used the Patchen and no PRE herbicides were the cheapest ($25/ha), these systems returned less money due to yield reductions from the early season weed interference. However, systems that used PRE herbicides banded and the weed sensing sprayer cost $75/ha less. Use of the weed sensing sprayer in the row middles was very effective and provided control equivalent to broadcast applied systems. The simulation of the weed sensing sprayer to trigger herbicide application on the drill appeared to be very effective and warrants additional research. Similar research was also conducted with soybeans and the trends were similar to what was seen in cotton.

Conclusions

I have worked over 15 years in applied weed management. I rate the weed sensing sprayer as one of the most exciting developments during this period, it is comparable to the development of the transgenic and glyphosate technology. The weed sensing sprayer is very accurate for control of emerged weeds in row middles and as we have shown, it can be modified to help manage weeds in the drill. There are a number of opportunities with this technology, including real time mapping of weed distributions and biomass (based on sensor signal strength) and the potential to use this spatial data for site specific application of soil applied residual herbicides. There are a number of advantages including 1) it is real time, 2) it can be operated by most producers and or their help, and 3) it does not require email, etc. to obtain site specific management data; thus it is very practical. The limitations are it cannot be used on narrow row spacing (under 30 inch rows) and it cannot tell the difference between crops and weeds. The weed sensing sprayer can reduce herbicide inputs and increase economic profitability.

Publications

Askew, S. D., S. B. Clewis, and J. W. Wilcut. 2001. Real-time site specific management in glyphosate-resistant cotton. Proc. South. Weed Sci. Soc. 54: (in press).

Troxler, S. C., A. J. Price, S. D. Askew, S. B. Clewis, J. W. Wilcut, and W. D. Smith. 2001. Site specific weed management in glyphosate-tolerant soybean (*Glycine max*). Proc. South. Weed Sci. Soc. 54: (in press).

Wilcut, J. W., S. D. Askew, G. H. Scott, and S. B. Clewis. 2000. Evaluation of a weed sensing hooded sprayer for weed management in cotton. Proc. Beltwide Cotton Conf. Vol. 2:1490.

Both the cotton and soybean data have been analyzed and manuscripts are in preparation for publication of refereed journal articles. Additionally, Mr. Troxler's poster presentation won first place in his section at the Southern Weed Science Society meeting.